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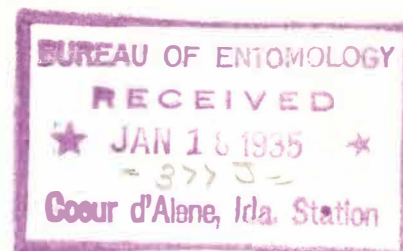
SUMMARY REPORT ON THE EUROPEAN SPRUCE SAW FLY FOR  
1934

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## SUMMARY REPORT ON THE EUROPEAN SPRUCE SAWFLY FOR 1934.

R. E. Balch.

### INTRODUCTION.

This is the third of a series of annual summary reports on the European spruce sawfly situation, prepared chiefly for the information of foresters, woodlands managers, and other officers of pulp and paper or lumber companies. It outlines the results of investigations by the Division of Forest Insects of the Dominion Entomological Laboratory at Fredericton, N.B., in so far as they have an immediate bearing on questions of management, including particularly control and salvage.

During the past season biological studies have been continued near the head of the Cascapedia river where special attention has been paid to the fluctuations of the sawfly population and the factors responsible for increases or decreases in numbers. The effect of the attack on the trees is also being followed closely in this locality, which is in the heart of the infested area. At the same time, similar biological studies have been commenced at the Parke Reserve in Kamouraska county, P.Q., and near Fredericton, N.B., where conditions are somewhat different and knowledge can be secured regarding the possible behaviour of this species in other parts of Eastern Canada. This work is essential as a basis for recommendations regarding parasite introduction or other control measures, or for determining plans for salvage.

In connection with our general survey of the infested area we are dependent to a large extent on the assistance of the companies and the provincial forest services in sending us reports. We shall be glad to receive reports of any kind regarding the sawfly, especially if accompanied by samples of the cocoon population. An illustrated leaflet describing the insect and the method of taking samples is available on request. We again acknowledge the continued co-operation of the companies operating in the Gaspé, particularly the International Paper Company and the Hammermill Paper Company, in forwarding the results of surveys, taking cocoon samples and meteorological records, and liberating parasites. The Quebec Forest Service has assisted in the establishment of a field station on the Parke Reserve. The Quebec Forest Industries Association Limited, together with the Southern St. Lawrence Forest Protective Association, has co-operated in the exchange of information and the members of the latter association have joined with the Quebec government in accelerating by financial contributions the work of parasite introductions.

### HISTORY PRIOR TO 1934.

As indicated in the previous reports, this species of sawfly appears to have been introduced from Europe and was first noticed in this country in

1930, attacking white and black spruce throughout the interior of the Gaspé. Increment studies of several hundred trees indicate that the outbreak was well advanced in 1929 and that sufficient numbers were present in 1928 to cause a reduction in growth in the white spruce. Black spruce was apparently attacked a year or more later. The outbreak is, therefore, at least seven years old and the sawfly has probably been numerous in the Gaspé for at least ten years.

The first year, however, in which the accumulated effect of the annual destruction of old foliage was sufficient to attract attention was 1930. In 1931, the greater part of the old needles of black and white spruce over about 2,500 square miles had been destroyed. In 1932, the season was somewhat unfavourable to the insect and the amount of old foliage lost was about balanced by the new growth. During the following year, however, conditions were favourable to the sawfly, an unusually high percentage of adults emerged, and larvae were more numerous than before. Practically all the old foliage was destroyed on white spruce and black spruce slopes were in almost as bad condition. The overwintering population of cocoons was two or three times greater than in previous years. The heavily infested area covered about 4,000 square miles.

During this time an outbreak of the eastern spruce bark-beetle (Dendroctonus piceaperda Hopk.) developed over the same area. This reached its peak in 1932 and is now definitely over. It has, however, killed almost half the volume of the white spruce in the mature stands throughout a great part of the peninsula. This is a native insect, periodically destructive to large spruce, particularly white spruce.

#### THE 1934 ATTACK.

Although the percentage of adult emergence from the overwintering cocoons was lower this year than last, the number of cocoons already in the ground was greater and the total emergence was about the same. The weather was, on the whole, fairly favourable to the larvae, which were numerous enough to destroy practically all the old and new foliage of a considerable percentage of the mature white spruce in the heavily infested area (see map). The remainder of the white spruce on this area has been stripped of practically all the old foliage and much of the new. Black spruce slopes have been almost as seriously attacked, from the valleys to the tops of mountains, and have lost most of the old needles and a considerable proportion of the new. On flats, the black spruce has been less seriously injured but the damage increased noticeably this year.

At the same time, a certain amount of spread has taken place and the heavily infested area now covers at least 5,000 square miles.

The above applies to the Gaspé area, roughly, from the Matapédia valley east. In the small area of heavy infestation in Kamouraska county, the sawfly behaviour was peculiar. Less than 2 per cent of the overwintering larvae developed into flies

during the season. The rest remained dormant and will emerge in 1935, or in subsequent years, except for a small percentage which will die and a larger number (possibly 30-40 per cent) which will be destroyed by mice and shrews. As a result, the attack in this area was very light and the trees had an opportunity to replenish their reserves of foliage somewhat, except for a few which were killed by the 1933 attack.

In New Brunswick, where the sawfly is generally distributed but comparatively scarce at present, a distinct increase in numbers took place. A considerable flight of adults occurred which tended to distribute the infestation and at the same time check its local increase. The larvae were quite numerous, however, over several areas a few square miles in extent, particularly in the centre of the province between the Miramichi and Salmon rivers. Although no serious damage was done, the defoliation was noticeable at these points.

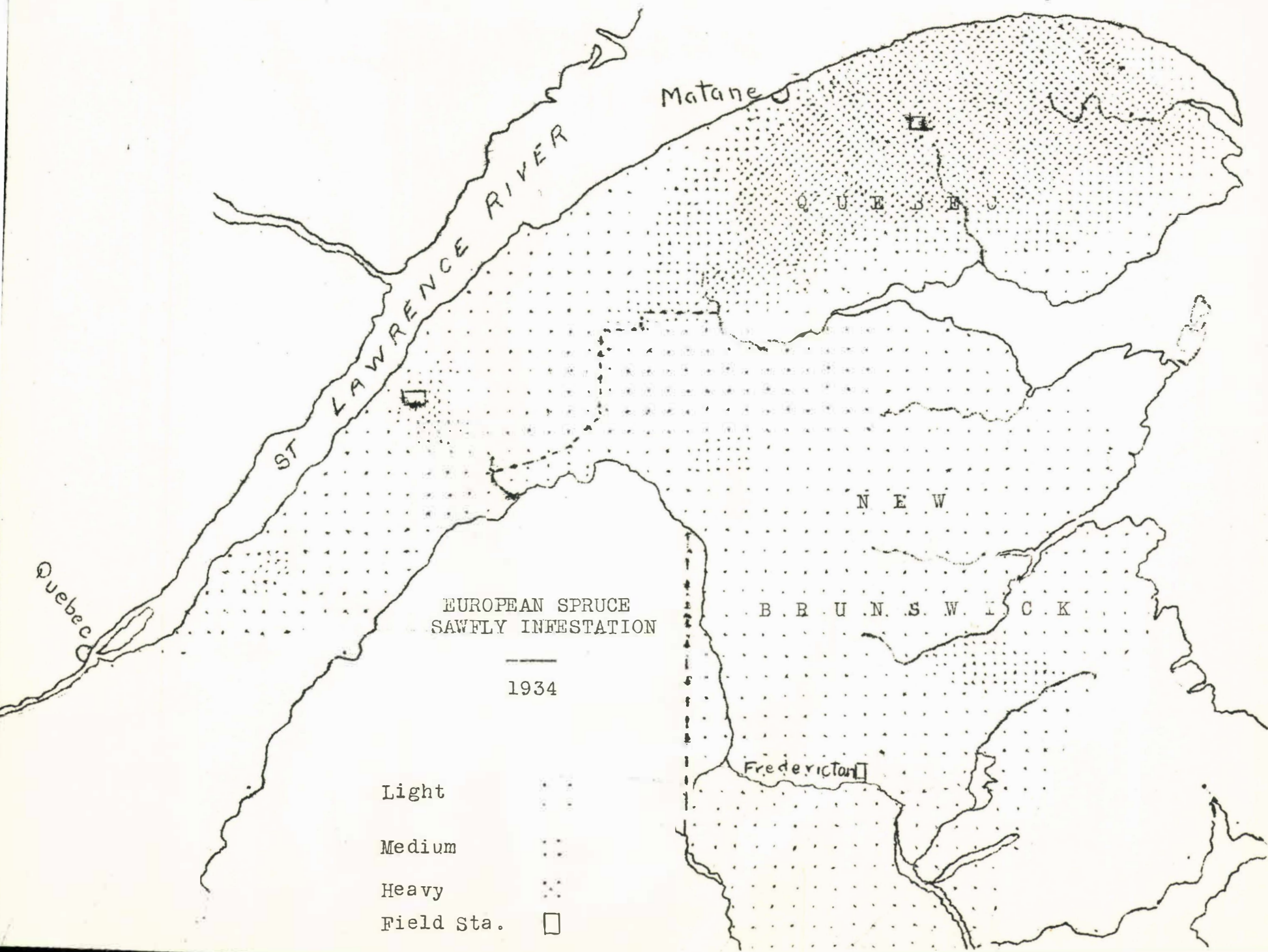
**EXTENT OF THE INFESTED AREA.** The extent and degree of infestation is shown on the map. The larvae have been found in every county in New Brunswick except Albert, St. John and Kings counties where a systematic search has not yet been made. They are quite common in Montmagny county, within 40 miles of Quebec city. An adult has been taken on the north side of the river near Quebec. No specimens have yet been found in Nova Scotia.

During the past season we have obtained evidence that when there is warm, calm weather during the time of emergence of the adults they tend to fly considerable distances. They are capable of travelling at least one or two miles and their direction is determined chiefly by the wind. The power of spread is, therefore, considerable. In the Gaspé, they have been drawn by air currents down the valleys to the north shore of the peninsula where a good many have, doubtless, been lost in the sea. Many are also carried to the tops of mountains, above the timber line.

In examining the map it should be remembered that the sawfly population is something like twenty times as great in the "heavy" area as in the "light". Also, the insect is known to be present in small numbers in the extreme south of New Brunswick as well as in Maine.

**DAMAGE.**

In discussing mortality it is necessary to adopt some criterion of death. Trees, for instance, may be so severely injured that they are incapable of recovery, but, particularly if injured in the fall, they will frequently remain green all winter and may put out new foliage next year. Some will apparently recover and put out new foliage for two years, or even more, before they finally succumb. Such trees, however, are not considered to be dying as long as the bark on the lower stem appears normal. The first sign of death is taken to be the browning of the inner bark in the neighbourhood of the phloem. This seems to constitute the first evidence to the naked eye of a condition from which there is no hope of even temporary recovery.





Discolouration of the foliage may not take place for some time after this.

When trees are attacked by bark-beetles, they are considered as dead provided the beetles are seen to be living and successfully making galleries beneath the bark. Quite often trees are able, temporarily at least, to resist bark-beetle attack, in which case the attempts of the beetles to make galleries are frustrated by a considerable flow of pitch into the galleries. They are then said to be "pitched out".

A fairly accurate estimate of the mortality was made on one or two drainages on the upper waters of the Cascapedia and Ste. Anne rivers by cruising. The same valleys were cruised as in the two previous years. The results may be considered to represent, roughly, the condition of the forest throughout much of the interior of the Gaspé. As before, the lines were run across the valleys as far as the white spruce occurred. They were not carried up the steeper slopes, which are occupied by black spruce in this area, and they represent a sample of the merchantable timber (4" D.B.H. and over) on the more accessible sites where white spruce occurs.

The average stand per acre on these lines was as much as 36 cords of spruce and balsam. Of this, 49 per cent was balsam, 45 per cent white spruce, and 6 per cent black spruce. Of the white spruce 46 per cent had been killed, and of the black spruce 17 per cent. That is, a total of about 8 cords per acre, consisting of the larger spruce on the more accessible sites, was definitely dead in 1934 from bark-beetle attack.

In spite of the high degree of defoliation in 1933, comparatively few trees actually died in 1934, except those attacked by bark-beetles. Not more than 1 per cent of the spruce died from sawfly attack alone, although some of the trees attacked by the beetles were in a dying condition and probably would not have been successfully attacked if they had not been defoliated to such a serious degree.

It may be said that almost complete defoliation is necessary to kill the average spruce tree. This condition was not reached on any considerable number of trees until October, 1934. At that time, however, a large percentage of the remaining white spruce throughout the interior was almost completely defoliated. Next year these will begin to die, but they will probably remain "green" during the winter. The percentage of completely defoliated black spruce is considerably smaller but on the slopes practically all the old foliage and a certain amount of the new has been eaten.

#### THE FUTURE.

The bark-beetle outbreak reached its peak in 1932 and is now at an end. In 1934, less than 2 per cent of the white spruce on our cruise lines were attacked and the number in 1935 will probably be considerably smaller. (It should be remembered that these



trees do not appear dead in the distance until the year following attack).

The bark-beetle is a native species, periodically destructive to mature spruce. It will probably not appear again for a number of years. The sawfly, on the other hand, remains as a threat to the spruce of all ages in the Gaspé, and to Canadian spruce forests in general. Being a European species, its behaviour is less predictable. Our studies indicate, however:

1. It is still unattacked by native parasites.
2. Control by shrews and mice is very helpful in delaying the increase in numbers but does not seem likely to prevent increase effectively.
3. Climatic factors of control are important but do not as yet appear to be capable of more than temporarily checking the increase in numbers. This would appear to be true of New Brunswick as well as much of Quebec, in spite of the fact that many larvae may sometimes be caught on the trees at freeze-up.
4. The sawfly is capable of two generations a year in most of New Brunswick. In cold seasons this may result in a considerable loss of larvae in the second generation but normally it should enable outbreaks to develop more rapidly.
5. White spruce is the preferred host and serious outbreaks may possibly be contingent on its presence. Both red and black spruce, however, are readily attacked in the presence or absence of white spruce and ultimately may prove to be almost equally susceptible to injury.
6. The life-history and habits of the sawfly are such that, in the absence of effective parasites, it is capable of continuing its attack for a considerable number of years and is less subject than most species to being suddenly wiped out. Widespread destruction of trees, for the same reasons, is less likely to take place rapidly than from the accumulated effect of feeding over a fairly lengthy period. There will, however, be local variations and distinct fluctuations in the population from year to year.
7. In the heavily infested areas the population of hibernating larvae in cocoons was somewhat less in the fall of 1934 than a year previous. This is the result of a combination of factors, including low emergence of adults, scarcity of foliage, larvae caught on the trees by freeze-up and increased effectiveness of shrews in the presence of large numbers of cocoons. The numbers, however, are still greater than at any time previous to 1933 and the reserve of foliage is smaller. There has been an increase throughout New Brunswick.
8. Although factors of control may

appear which will prevent serious damage over large areas outside of the Gaspé, the evidence of the past season has not increased the probability of this. The outbreak remains a serious menace. The example of the European larch sawfly is sufficient indication of the destructive capabilities of such insects.

9. The probabilities are that practically all the white and a good deal of the black spruce throughout the greater part of the Gaspé will be killed in a few years. Both species may be almost totally destroyed in this area in the near future.

#### CONTROL.

Where trees are of sufficient value to warrant the expense, the larvae can be killed by the application of calcium arsenate as a spray or dust. Owing to the habit of a large percentage remaining dormant for one or more years, and to the influx of adults from neighbouring untreated areas, such operations would have to be repeated. Particulars regarding such methods can be given on request. They should not be attempted without full consideration of the local circumstances.

The only hope at present of bringing about permanent control in the forest seems to lie in the importation of parasites from Europe. This work has been proceeded with during the past season as energetically as possible. As a result of arrangements made by the Dominion Entomological Branch, parasites have been received from the Farnham Royal Laboratory, Imperial Institute of Entomology, and reared at the Belleville parasite laboratory. The work has been speeded up by the generous assistance of the Quebec government and the Southern St. Lawrence Forest Protective Association through the Quebec Forest Industries Association, Limited. Close to a million of these parasites have been liberated at the most strategic points, which for the most part lie outside the margin of the heavily infested area. The work of collecting, importing, rearing and liberating is being continued.

It is too early to estimate the possibilities of success. A number of species are being tested and it may be some time before it is definitely known how well these are adapted to our conditions and how rapidly they can multiply at the expense of the sawfly. Some very encouraging results have been obtained with an imported parasite of the larch sawfly and there is every reason for exploring all the possibilities of control by this means. The season of 1935 will give some preliminary information regarding the behaviour in the field of those species which have been liberated.

#### SALVAGE.

Some salvage operations have already been commenced. Wherever economically possible, plans should be made immediately for such operations in the heavily infested area. A good deal of the area is not readily accessible and the costs of transportation are high. For this reason the loss of the spruce, forming as it does approximately half of the average merchantable stand, would mean the total loss of the stand as the remaining balsam would not form the

basis of a profitable operation.

As shown in the report by Mr. C. G. Riley, of the Division of Botany, the percentage of actual decay in the merchantable volume of white spruce killed three years ago is not more than 3 per cent, and in trees killed more recently it is very slight. This suggests that the dead trees are in a better condition for salvage than would appear from a casual inspection. However, it must be remembered that the above figure does not include the so-called "brown sap stain" which "quickly invades the entire sapwood and gives the end of the log a very poor appearance". This may prove to be a forerunner of decay, and, together with the inevitable "blue stain", may cause serious discolouration.

The amount of decay is decreased by the removal of the bark by woodpeckers, which commonly occurs in the case of trees killed by the bark-beetle. Trees killed by sawfly alone may possibly decay more rapidly owing to the bark remaining on them.

While it would appear that the spruce may remain more or less free from serious decay for two or three years, it deteriorates somewhat from stain and ambrosia beetle attack shortly after death. Borers do not seem to be very numerous in the Gaspé.

Owing to the large amount of timber involved and the length of time which it would take to salvage any considerable part of it, all operations of this nature which are possible under present conditions should be commenced without delay. The unsalvaged forest will be a serious fire hazard for many years.

In general, clear cutting is advisable in this area owing to the almost inevitable loss of trees left from windfall, and to the fact that sawfly attack will be concentrated on any spruce remaining after a cut.

**EFFECT ON FOREST COMPOSITION.** Balsam forms the greater part of the advance growth and reproduction. The present proportion of spruce in the forest is due largely to its greater persistence eventually making up to some extent for its inferior powers of reproduction. A very heavy seed year which occurred in 1934 should assist in maintaining a certain proportion of spruce in the reproduction, but the destruction of the spruce will undoubtedly increase the balsam content. An operation in which clear cutting is practised may encourage spruce reproduction by exposing the ground to warmer conditions and disturbing the soil. This, however, has not been studied. It would in any case remove the balsam seed trees.

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